Rare-earth Information Center NEWS

Center for Rare Earths and Magnetics
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Institute for Physical Research and Technology
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Biochemistry of Sc and Y

Analytical techniques reveal that Scandium and Yttrium are present in plant and animal living tissues in the few species that have been studied so far. This knowledge may have far-reaching implications for researchers in the biological and environmental fields. *Biochemistry of Scandium and Yttrium* is published as a two part series, Part 1: *Physical and Chemical Fundamentals* presents a comparative study of the physical and chemical properties of both Sc and Y, addressing both their similarities and differences. It also discusses the interactions of Scandium and Yttrium with biological molecules such as organic acids, carbohydrates, proteins, nucleotides, and other biologically active molecular species. Part 2 will specifically address the biochemical aspects of these two elements, as well as various medical and environmental implications.

The book contains six chapters: "History of Yttrium and Scandium" provides a concise background of these elements and is a welcome 20-page preface to this two-part series. Chapter 2 "Chemical and Physical Properties of Scandium and Yttrium" relates the electronic configurations, bonding and coordination chemistry, isotopes, and other chemical and physical aspects of these elements. The next chapter is essential to those interested in a description of the analytical techniques involved in determining the qualitative and quantitative constituents of Sc and Y-containing materials. The next three chapters deal with the occurrence of these elements in nature, including organisms and molecules of biological interest.

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Search of the Month

The sample search below satisfies a request for information on rare earths perovskite compounds that exhibit magnetoresistivity.

RIC searches utilize the Boolean operand system with "+" = (or), "*" = (and), and "* ^" = (and not). Many more citations would have been referenced had we included specific compound/alloys.

RARE-EARTH INFORMATION CENTER LITERATURE SEARCH REPORT
Laser Ablation of Nd-Fe-B

(ND2FE14B + (ND,B,FE)) * LASER#

TERM	KEYWORDS INDEXED	NUMBER IN REQUESTS
ND2FE14B	875	2
(ND,B,FE)	1834	9
LASER#	1782	10
********	10 DOCUMENTS HAVE SATISFIED THIS REQUEST	*******

The above Literature Search Report shows the key words used in the search, the number of times each appears in the data base, and that 10 documents that contain information on laser ablation in Nd-Fe-B alloys were referenced in the search. More papers can be referenced by requesting specific compounds.

The cost to receive the Literature Search List from this search, which is a complete listing of all 10 referenced documents, is available for US$50.00. Supporters can receive as many searches as needed for US$300.00 per year (corporate) or US$100.00 (individual).

As an added benefit, supporters receive the 2-page monthly newsletter *RIC Insight* that reports on late-breaking news of rare earths and how these developments may impact the rare earth industry.

If you would like us to conduct a search for you, please send your request to: Dr. R. William McCallum, RIC, 106 Wilhelm Hall, Ames Laboratory, Iowa State University, Ames, IA 50011-3020 USA; Tel: 515 294 4736; Fax: 515 294 3709; ric@ameslab.gov. ▲

The major aspects of Scandium and Yttrium in science, technology, and medicine should be interesting to geochemists, inorganic and organic chemists, clinical biochemists, and those involved in environmental health and protection. *Biochemistry of Scandium and Yttrium*, Parts 1 and 2 are Volumes **13A** and **13B** of the *Biochemistry of the Elements* series published by Kluwer Academic/Plenum Publishers. The 324-page hardcover book (Part 1) was published in 1999 and is available for US$175.00 by contacting the publishers at 233 Spring Street, New York, NY 10013-1578 USA; Tel: 212 620 8000; Fax: 212 463 0742; kluwer@wkap.com. ▲

Polymer Bonded Magnets 2000

Intertech's magnet and magnetic materials division will offer its 5th international bonded magnet conference *Advanced Technologies, Market Trends and Customer Requirements for Polymer Bonded Magnets 2000.* The conference will be held March 27-29, 2000 in Nashville, Tennessee, USA and will include tutorials on the design and application of polymer bonded magnets, and methods for and technologies for magnetizing and testing polymer bonded magnets. The conference will be made up of four sessions: Bonded Magnet Market Dynamics for the 21st Century, Product Design and Bonded Magnet Applications, Regional Market and Technical Outlook, and Material, Process and Production Innovations.

To register, contact Intertech, 19 Northbrook Drive, Portland, ME 04105 USA; Tel: 207 781 2150; Fax: 207 781 9800; info@intertechusa.com. ▲

Permanent Magnet Design

The 17th Technology Short Course and Workshop on Permanent Magnet Design will be held May 1-3, 2000 in Research Triangle Park, North Carolina, USA. The course will apprise the permanent magnet designer, engineer or technical manager of the latest developments in materials properties and processes, magnet behavior, modern methods for magnetic circuit design and analysis, with a number of design studies including motors, actuators and sensors. The studies will include applications in automobiles, consumer products, medical devices, computers, office products, and micro-turbines. Special emphasis will be placed on Nd-Fe-B and Sm-Co type magnets, as well as a wide range of bonded magnets. A workshop session will be held at the new Magnequench Technology Center which will provide an interactive demonstration of finite element software and a range of magnetization and permanent magnet characterization equipment.

For more information, contact Princeton Electro-Technology, Inc., 2701 Stratford Hall Drive, Raleigh, NC 27614 USA; Tel: 919 274 6362; Fax: 919 488 6363; info@magnetweb.com; http://magnetweb.com/course.htm. ▲

Conference Calendar

*** A NEWS STORY THIS ISSUE**

Note: Reach as many potential conference attendees as possible! Send us your conference announcement and we will publish it here. ▲

March '00
Rare Earths and Actinides: Science, Technology, and Applications IV
Nashville, Tennessee, USA
March 12-16, 2000
RIC News **XXXIV**, [2] 2 (1999)

Polymer Bonded Magnets 2000
Nashville, Tennessee, USA
March 27-29, 2000
*This issue

May '00
Permanent Magnet Design
Research Triangle Park, North Carolina, USA
May 1-3, 2000
*This issue

NATO ASI: Modern Trends in Magnetostriction Study and Application
Crimea, Ukraine
May, 2000
RIC News **XXXIV**, [3] 3 (1999)

Nineteenth International Conference on Properties and Applications of Magnetic Materials
Chicago, Illinois, USA
May 22 – 24, 2000
*This issue

June '00
NATO ASI: Magnetic Storage Systems BEYOND 2000
Rhodes, Greece
June 13 – 23, 2000
RIC News **XXXIV**, [3] 2 (1999)
RIC News **XXXIV**, [4] 2 (1999)

August '00
Seventh International Symposium on Magnetic Bearings
Zurich, Switzerland
August 23-25, 2000
*This issue (page 3)

September '00
ICFE'4
Madrid, Spain
September 17 – 21, 2000
*This issue (page 3)

The Third International Conference "Noble and Rare Metals" (NRM-2000)
Donetsk, Ukraine
September 19-22, 2000
RIC News **XXXIV**, [1] 3 (1999)
*This issue

September '01
Rare Earths - 2001
São Paulo - SP, Brazil
September, 2001
RIC News **XXXIII**, [4] 3 (1998)

Magnetic Materials Conference

The Nineteenth Annual Conference on Properties and Applications of Magnetic Materials will be held at the Illinois Institute of Technology, Chicago, Illinois, USA, May 22 – 24, 2000. The conference will bring together engineers and scientists with users and suppliers of magnetic materials. Representatives from industry and academia will discuss recent developments and project future requirements of magnetic materials.

The conference will consist of four sessions, each one lasting one half day: Techniques and Applications of Magnetic Modeling, Electrical Steels I and II, and Advanced Magnetic Materials. Several areas related to magnetic materials will be covered, including quality control for the manufacture of magnetic materials, electrical machine design and construction of magnetic devices, and innovative magnetic materials for technological applications. Contact Bonnie Dow, Illinois Institute of Technology, Hermann Union Building, Main Campus, Chicago, Illinois; Tel: 312 567 6809; Fax: 312 567 8976; bonnie@ese.iit.edu. ▲

Magnetic Bearings Symposium

The Seventh International Symposium on Magnetic Bearings will be held August 23 – 25, 2000 in Zurich, Switzerland. The Symposium will cover all aspects of magnetic bearings, with special emphasis on field experiences and applications. Session topics include applications such as aircraft engines, pumps, centrifuges, compressors, flywheels, guideways, turbines, space equipment, physical devices, spindles, and vibration isolation; safety and reliability; components and materials; modeling, dynamics, and control; superconductivity, micro bearings, and other novel areas.

The Symposium will be accompanied by an exhibition by magnetic bearing manufacturers and research laboratories that will display their magnetic bearing systems, products and components. The Symposium will be preceded by a one-day tutorial an August 22, which will include theory and applications in magnetic bearing systems. Topics will include bearing operation, bearing layout, amplifier and sensor systems, rotor design and modeling, controller layout, and simulation. Various industrial applications will also be discussed, led by experienced magnetic bearing specialists.

For more information, contact the International Center for Magnetic Bearings, ETH Center/CLA, 8092 Zurich, Switzerland; Tel: 41 1 632 35 82; Facsimile: 41 1 632 15 10; E-mail: amb@ifr.mavt.ethz.ch; www.ifr.mavt.ethz.ch/ismb7. ▲

ICFE'4

The 4th International Conference on *f*-elements (ICFE'4) will be held September 17-21, 2000 in Madrid, Spain, and will focus on basic research such as synthesis, structural characterization and physical properties, as well as applied multidisciplinary relevant aspects in which rare earths are utilized. The program will cover different topics related to the synthesis and properties of novel rare earth compounds with applications in the field of electronics, optics, lasers, magnetism, catalysis, medicine, bio

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Luminescence of Zr-Eu-O-N Powders

In the last two years a group of scientists from the University of Würzburg, Germany and the University of Sofia, Bulgaria for the first time has prepared Zr - Eu - O - N ceramic powders with an europium content between 0.67 and 6 mol % and a nitrogen content between 0.67 and 3 mol %. The oxidation number of Eu is III as indicated by ESR measurements. The Zr - Eu - O - N ceramic powders prepared show a red Eu(III) luminescence with a $t_{1/e}$ lifetime varying from 0.3 to 1.40 ms at 535 nm room temperature excitation and 615 nm monitoring. The powder reflectance at 615 nm is varying from 50 % to 65 %. The Zr - Eu - O - N powders are prepared using direct nitridation (see M. Lerch, *J. Am. Ceram. Soc.* **79** (1996) 2641 - 44) of ZrO_2:Eu(III) at 1600 - 1900°C and a subsequent reheating at 600°C. Our luminescence measurements clearly showed that little amounts of nitrogen dramatically affect optical properties like color, reflectance, emission and luminescence lifetime of rare earth doped oxides. Additionally, using the Eu(III) luminescence as a monitor, we found that the nitrogen incorporation in ZrO_2:Eu favors the formation of non-centrosymmetrical Eu(III) luminescent centers.

The basic result of above summarized investigations, sponsored by the A. von Humboldt Stiftung (Germany) are to be published in a paper

Luminescence in next column ☛

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medicine, environment, industrial processes, superconductors, coordination and organometallic chemistry, and spectroscopy. Highlighting conference will be the presentation of the first European Rare Earth Society (ERES) Award for young researchers in rare earths.

For more information, contact D.ª Ana González Limón, Sección de Congresos – Facultad de Medicina, Universidad Complutense de Madrid, E-28040 Madrid, Spain; Tel: 34 91 394 16 15; Fax: 34 91 394 13 14; congress@eumax.sim.ucm.es; www.icmm.csic.es/icfe4. ▲

Changzhou Jiangfei Rare Earth Co., Ltd.

Changzhou Jiangfei Rare Earth Co., Ltd. was established in 1996 and specialized in the separation and production of rare earth oxides. Today, the company produces high-purity rare earth oxides and REO coprecipitation products that are used in activator, catalysts, additives, automotive catalytic converters, pigments and glass colorants, CRT phosphors, atomic absorption materials, hydrogen storage alloys and permanent magnet materials. The company operates 20,000 square meters of buildings on 100,000 square meters of real property. The plant treats more than 2,000 mt of rare earth ore each year.

For more information, contact the company: Xinghua Bridge, Changzhou, Jiangsu, 213144, People's Republic of China; Tel: 86 0519 3632377/ 13901508187; Fax: 86 0519 363 2377; E-mail: jfgs1234@pub.cz.jsinfo.net; www.jf-re.com. ▲

☛ *Luminescence from previous column*

"*The Luminescence of Zr - Eu - O - N Materials*" in **Journal of Physics and Chemistry of Solids (2000)** under the authorship of S. Gutzov, M. Kohls ,and M. Lerch. For more information contact: S. Gutzov, University of Sofia, Faculty of Chemistry, Department of Physical Chemistry, 1. J.Bourchier Blvd., 1126 Sofia, Bulgaria; sgutzov@chem.uni-sofia.bg.

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Feedback Wanted

A computer code for the electronic structure calculations of *f*-elements is available for free download at http://chemistry.anl.gov/spectra/. Feedback should be sent to Dr. Victor Zhorin, Chemistry Division, M151, B.200, Argonne National Laboratory, Argonne, IL 60439 USA; Tel: 630 252 7394; zhorin@anl.gov. ▲

Handbook of Magnetic Materials Vol. 12

The *Handbook of Magnetic Materials* is a continuation of *the Handbook of Ferromagnetic Materials* series started by Peter Wohlfarth in 1980. Now edited by K.H.J. Buschow, the *Magnetic Materials* series is intended to be of assistance to those needing an introduction to a given topic in the field of magnetism without the need to review a vast amount of published literature. It also serves the needs of research scientists as a reference book that provides basic information on the current state of magnetism and magnetic materials.

Volume **12** consists of four chapters. The first chapter "Giant Magnetoresistance in Magnetic Multilayers" which focuses on giant magnetoresistance (GMR) in magnetic multilayers, spin valves, multilayers on grooved substrates and multilayered nanowires. It also is comprised of theoretical models which examines the experimental data to explain the underlying physics of GMR. Chapter two reviews the results obtained by nuclear magnetic resonance (NMR) on thin magnetic films and superlattices. It is written for scientists who are familiar with the preparation and properties of thin magnetic films but are looking for additional information on the NMR of ferromagnetic materials. Chapter three "Formation of 3d-Moments and Spin Fluctuations in Some Rare-Earth-Cobalt Compounds" examines rare earth compounds with 3*d* transition metals, in particular those that exhibit a magnetic instability of the 3*d* subsystem. It focuses on such compounds in which the 3*d* electron subsystem is neither nonmagnetic, nor carries a stable magnetic moment. Attention is focused on the Co-based Laves phase compounds such as RCo_2, and with nonmagnetic rare earths such as YCo_2, $LuCo_2$, and $ScCo_2$. Other compounds covered are $Y(Co,Al)_2$, $(Er, Lu)Co_2$, and other $(R,R')Co_2$ compounds, and temperature and pressure effects on resistivity of $ErCo_2$. The last chapter deals with the magnetocaloric effect of $Gd_5(Ge,Si)_4$, and other rare earth metals, oxides, and intermetallic compounds.

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The 586-page hardcover book was published in 1999 and is available for US$215.00 from Elsevier Science B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands; Tel: 31 20 485 2603; Fax: 31 20 485 2425; www.elsevier.nl; in the USA, Elsevier Science Inc., P.O. Box 945, Madison Square Station, New York, NY 10160-0757 USA. ▲

Rare Earths '98

Proceedings of the International Conference on Rare Earths, held in Freemantle, Western Australia, October 25 – 30, 1998 is published as the 624-page book *Rare Earths '98*. The conference was host to 175 delegates, of which 141 were from foreign countries. The conference contains contributions covering the topics of photophysics, luminescence, and spectroscopy, magnetic materials, nuclear medicine therapy, minerals and materials characterization, coordination chemistry, extraction and coordination chemistry, agricultural applications, rare earth marketing, and new applications.

The proceedings contain 80 interesting contributions that cover a wide range of topics, such as - occurrence and effect of rare earths in agricultural soils and that there is no beneficial effect that rare earths have on increasing agricultural plant production; preparation of 20-200 nm particle size Ce_2S_3 powders; the production of rare earth polishing powders in Russia, and the recovery of rare earths from used polishing compounds; China's rare earth industry (including production and consumption figures); $^{166}Ho(NO_3)_3$ therapy for malignant and benign tumors; acid curing of bastnasite ore and concentrate; magnetization of Nd-Fe-B permanent magnet materials; and several papers that deal with the ultraviolet absorption of rare earth compounds. The book also contains research on luminescent materials and the crystal growth of rare earth vanadates and phosphates as well as rare earth coordination compounds.

The 608-page soft cover *Rare Earths '98*, edited by R.C. Woodward and published in 1999 and is available for US$238.00 by contacting: Trans Tech Publications Ltd., Brandrain 6, CH-8707 Uetikon A.S., Switzerland; Fax: 41 1 922 10 33; ttp@ttp.net. ▲

$Sc_2N@C_{80}$

The first isolated fullerene that encapsulates a four-atom cluster was discovered by researchers at Virginia Polytechnic Institute & State University {*C&EN*, **77**, [38] 54-5 (1999)}. The interest in the research was prompted by the resulting spectral peak of an unidentified substance when scandium-containing fullerenes were produced in an electric-arc reactor. In the procedure, Sc_2O_3 was packed into two graphite rods and arc-vaporized under a helium atmosphere, which produces fullerenes that hold one, two, or three Sc atoms inside a variety of carbon cages. The small amounts of endohedral metallofullerenes produced such as $Sc_2@C_{84}$ and $Sc_3@C_{82}$ are easily identified by their mass spectral peaks. However, a unique peak appeared that was eventually identified as a scandium-nitride fullerene, $Sc_3N@C_{80}$. The initially unwanted nitrogen atom may have been introduced via an air leak in the system, but nitrogen was later added as a key ingredient to produce the new molecule.

According to the lead scientist, Harry C. Dorn, the x-ray structure of the new molecule resembles a "whirling Mercedes-Benz emblem inside a ball" and is believed to be the first isolated fullerene that encapsulates a four-atom cluster. $Sc_3N@C_{80}$ is unique from other endohedral fullerenes since its three central Sc atoms are not only bound to the central N atom of the Y-shaped cluster, but to some C atoms of the cage. This may be because each of the Sc atoms is within bonding distance of two C cage atoms, but the exact mechanism of the Sc-C relationship is unclear. The trimetallic cluster appears to whirl around the carbon cage, but at 130 K it appears at a fixed location.

They also demonstrated that other metals besides Scandium combine with nitrogen to form trimetallic nitride clusters. When graphite rods were packed with a mixture of Sc_2O_3 and Er_2O_3 and vaporized in the presence of nitrogen, C_{80} cages were produced that had a variety of trimetallic nitride clusters such as Sc_3N, $ErSc_2N$, Er_2ScN, and Er_3N.

The problem in identifying these

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Rare Earth Consultants

We receive referral requests from interested clients from time to time about consultants in the rare earth field. Several years ago we kept a list but it now needs updating. If you would like us to refer prospective customers to you for consulting services, just send us the following information:

- Contact Name
- Company Name
- Mailing Address
- Telephone Number
- Facsimile Number
- Electronic Mail Address
- URL
- Area(s) of Expertise

This listing is provided at no cost as part of the RIC's service to the worldwide rare earth community. The information should be sent to: LaVonne Treadway, 116 Wilhelm Hall, Iowa State University, Ames, IA 50011-3020 USA; Tel: 515 294 2272; Fax: 515 294 3709; RIC@ameslab.gov. ▲

☛ *Sc-Fullerene from page 4*

compounds previously is that they were not produced in significant quantities so as to be studied since metallofullerenes typically contain <0.5% of the soluble products and usually are produced as a mixture of several carbon-cage isomers. However, for example, Dorn's group was able to produce a yield of between 5 – 10% $Sc_3N@C_{80}$ of the soluble products, and only a single carbon-cage isomer (icosahedral C_{80}) is observed. The group now has optimized the preparation process by chromatography to produce 99.9% pure material and enough can be made for detailed studies.

By controlling the metals encapsulated in the cage, engineers can control physical, optical, and magnetic properties of the fullerenes, which may allow these new materials find applications in semiconductor devices, optical limiters, and quantum computing devices. In addition, they have potential as contrast agents for MRI and as radioactive tracers. Contact Harry C. Dorn, Virginia Tech, 1109 Hahn Hall, Chemistry Dept., Blacksburg, VA 24061 USA; Tel: 540 231 5953; hdorn@vt.edu. ▲

Consultant's Corner

To appear in our Consultant's Corner, any individual, company, or group must be involved in rare earth or rare earth-related consulting activities. Just send us the appropriate information: contact name, company name, mailing address, Tel/Fax number(s), e-mail and web address, and areas of expertise.

Paderno Yuriy: Institute for Problems of Materials Science of National Academy of Sciences of Ukraine, Rare Earth Refractory Compound Laboratory, 3 Krzhyzhanovsky Str., 03142 Kiev, Ukraine; Tel: 380 44 444 13 67; Fax: 380 44 444 21 31; paderno@ipms.kiev.us ▲ rare earth boride compounds and boride materials, synthesis, single crystal growth, directional crystallization, electron structure and properties investigations.

Peter Melnikov: Federal University of Mato Grasso do Sul State, Physics Department, CEP 79070-900, Campo Grande, Brazil; Tel: 55 67 787 1290; Fax: 55 67 787 1290; petrmelnikov@yahoo.com; pedrom@iq.unesp.br ▲ high purity rare earth phosphates and arsenates.

Sinko Resources, Inc.: David W. Sinclair, 444 Park Avenue South, Suite 602, New York, NY 10016 USA; Tel: 212 545 0450; Fax: 212 545 0457; sinko@worldnet.att.net ▲ marketing, supplies, developing, and processing of rare earth and related minor metals and chemicals for alloying, reduction and manufacturing.

University of Liverpool: Dr. Helen Aspinall, Department of Chemistry, Crown Street, Liverpool, L69 7ZD UK; Tel: 44 151 794 3528; Fax: 44 151 794 3588; hca@liv.ac.uk; http://int.ch.liv.ac.uk/Lanthanide/Lanthanides.html ▲ coordination chemistry, organometallic chemistry, lanthanide alkoxides, amides, thiolates, ligand synthesis, applications of lanthanide complexes to homogenous catalysis, asymmetric synthesis and catalysis.

Christopher Gross, 6998 McArthur Road, Canyon, Minnesota, 55717 USA; Tel: 218 345 8892; E-mail: mslk1@uslink.net ▲ Analysis of Rare Earths, superalloys, superconductors and superconducting compounds

Industry News

Electron Energy Corporation (EEC) has added a new line of polymer-bonded rare earth permanent magnets that offer the advantages of weight, size, price, and size, for a number of applications. EEC has developed a manufacturing process that bonds rare earth metallic powder with polymers. The new polymer-bonded magnets complement the company's line of rare earth sintered magnets. Ted Haberberger, Vice-President New Products, Electron Energy Corporation, 924 Links Avenue, Landisville, PA 17358 USA; Tel: 717 898 2294; Fax: 717 898 0660; magnetenergy@earthlink.net.

Indian Rare Earths Ltd. announces that V.K. Verma has been promoted to Director(Marketing) effective November 8th, 1999. The company offers a wide range of rare earth concentrates, oxides, and compounds. Indian Rare Earths Ltd., Sherbanoo, 6th Floor, 111, Maharshi Karve Road, Mumbai-400 020, India; Tel: 91 206 26 51; Fax: 91 200 44 30.

JXMEC (Shenzen) Enterprise Development Company, F/20F, Caihong Building, Caitian South Road, Futian District, Shenzen 518026, People's Republic of China; Tel: 86 755 2715255; Fax: 86 755 2174925; szjxmec@public.szptt.net.cn specializes in Rare Earth Oxide, Rare Earth Metal and Rare Earth Compounds.

Moltech Power Systems

Moltech Corporation purchased Energizer Power Systems (EPS) from Eveready Battery Company on November 1, 1999. The acquisition will allow the combination of strengths from two companies and creates a new rechargeable battery company.

Moltech Corporation, a Tucson, Arizona-based high technology company, has formed Moltech Power Systems, a wholly-owned subsidiary of Moltech Corporation. Moltech President and COO, Deward Manzer, will serve as Chairman of Moltech Power Systems. Joe Fisher, formerly the Vice President and General Manager of Energizer Power Systems, has been named President of Moltech Power Systems.

Ralston Purina announced its plans to exit the original equipment manufacturer (OEM) rechargeable battery business last April. On September 28, 1999 it was announced that Moltech had signed a definitive agreement to purchase Energizer Power Systems. The new venture combines Moltech's lithium-sulfur and EPS's nickel products, along with EPS's global assembly, sales and distribution network. According to Fisher, the company name has changed, but all other aspects of EPS including its relationships with customers and vendors will remain the same.

Moltech Corporation was founded in 1988 as a spin-off from Brookhaven National Laboratory. In addition to its own scientists, Moltech has collaborative agreements with a number of top research organizations around the world. Moltech is a leading developer of a new generation of advanced lithium batteries for portable electronic devices. The company also produces nickel-metal hydride rechargeable batteries for world markets.

Moltech Power Systems is a wholly-owned subsidiary of Moltech Corporation. Headquartered in Gainesville, Florida, the company provides rechargeable power solutions to device manufacturers worldwide. Moltech Power Systems has design, engineering, assembly and sales operations in North America, Asia-Pacific and Europe. For more information, contact Moltech Power Systems, P.O. Box 147114, Gainesville, FL 32614 USA; Tel: 904 462 3911; Fax: 904 462 4726; www.moltechpower.com. ▲

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High Temperature Sm-Co Magnets

Electron Energy Corporation (EEC) and the University of Dayton, Dayton, Ohio, USA, announce a new class of SmCo 2:17 magnets for applications requiring high temperature performance up to 550°C (see also *RIC News*, **XXXIV**, [4] 5 (1999). These magnets have low temperature coefficients of ${}_iH_c$ and a straight-line induction demagnetization curve up to 550°C. A straight-line demagnetization curve provides greater design flexibility and facilitates reduced size and weight of magnetic circuits. The straight-line curves are typical requirements for magnets used in dynamic applications.

The maximum operating temperature for the magnet, T_M, is defined as the maximum temperature at which a straight-line demagnetization curve can exist. Discreet magnet compositions are available for T_M at any temperature in the range of 250°C to 550°C. This control of magnet compositions provides the best combination of highest possible $(BH)_{max}$ and a linear demagnetization curve for each high temperature application. Investigations on the thermal stability of these materials at 300°C to 550°C shows that these high-temperature magnets, properly coated, will be suitable for use at high temperatures for long-term service.

The new permanent magnet materials were the result of a joint effort by the University of Dayton, Ohio and was supported by the U.S. Air Force and the U.S. Navy.

Details and information will be presented in Intermag 2000 papers DD-06 and AB-02. For additional information, contact: Electron Energy Corporation, 924 Links Avenue, Landisville, PA 17538 USA; Tel: 800 463 1869 / 717 898 2294; Fax: 717 898 0660; eec@electronenergy.com; www.electronenergy.com or John Durie (Scotland), Tel: 44 1 555 770 787. ▲

New Yb Phase

Trivalent Ytterbium is often considered the electron-hole symmetry analogue of trivalent Cerium. In the latter case there is one $4f$ electron, while in the former there is one $4f$ hole. This symmetry has been demonstrated in a number of compounds but until recently there has been no evidence to support the concept in pure metals. Ce metal exhibits a low temperature phase transformation below ~ 150 K which is accompanied by a volume collapse of ~ 17% and is a result of of an increase in the $4f$ - $5d$ interaction strength. No corresponding phase transformation has been observed for pure Yb.

Recently, using epitaxially grown thin films prepared below 190 K, a new Ytterbium metal phase has been identified. The new phase, that is stable up to 400 K, has been reported by E. Weschke, et al. Institut für Experimentalphysik,Freie Universität Berlin, Arnimallee 14, D-14195 Berlin-Dahlem, Germany {*Phys. Rev. Lett.*, **83**, [3] 584-7 (1999)}. The Yb metal sample was prepared by epitaxial growth of 100 Å-thick films at low temperature (below 190 K). The new phase is stable over a temperature range of at least 35 to 400 K and is characterized by a smaller lattice parameter than β-Yb while possessing a different $4f$ -electronic structure.

The researchers prepared the Yb metal films under ultrahigh vacuum conditions with base pressures of <1 x 10^{-10} mbar, with a maximum of ~5 x 10^{-10} mbar during evaporation. The starting material was 99.99% Yb that was evaporated from a radiatively heated tantalum crucible onto a tungsten substrate. In order to improve the crystal structure of the films, they were briefly annealed to 400 K. The samples were then cooled for x-ray diffraction and photoemission measurements. As determined by x-ray diffraction in situ, the spacing between close-packed layers is reduced by ~0.6% as compared to fcc phase β-Yb. This corresponds to lower $4f$ binding energy, which they observed via photoemission. Yb films grown at room temperature exhibited the normal β-Yb film structure.

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Solid Oxide Fuel Cells

Fuel cells convert chemical energy directly to electricity, which makes them highly desirable power sources for electric vehicles and small stationary units. Hydrogen-oxygen fuel cells are relatively simple and efficient but the energy density of liquid hydrogen is not particularly high, safety is a major issue, and no infrastructure exists for the mass production and distribution of the fuel. Solid oxide fuel cells (SOFC) use hydrocarbons to generate electricity by oxidizing methane or alcohol via an electrochemical cell. Their advantage is decreased noxious nitrogen oxides (NO_x) and CO_2 emissions as compared with the combustion of fossil fuels. They also offer efficient small-scale electrical plants that can operate for a local customer base. SOFC currently operate in one of two ranges. High temperature (900°C) fuel cells generate H_2 and CO internally and these products are then oxidized. In order to prevent a detrimental build up of carbon, steam must be injected into the cell. The energy required to generate the steam significantly degrades the efficiency of the cell. Low temperature fuel cells require that the H_2 and CO be generated externally which increases complexity and decreases efficiency.

The ideal fuel cell would oxidize the methane directly in the stack without the intermediate generation of H_2 and CO. Based on a recent paper {Murry et al, *Nature*, **400**, 619-21, (1999) www.nature.com} it appears

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☛ *Yb Phase from previous page*

The authors suggest that this new fcc phase and β-Yb appear to resemble the relationship in the isostructural γ - α phase transition in Ce metal. This new phase is not believed to be the hcp a phase of Yb since it does not have the related expanded lattice. They do not explain if this new phase is characterized by an increased 4*f* hybridization with valence states, or by a change in the 4*f* level alone, such as in a change in 5*d*-6*s* hybridization. The answer may be found through further research to determine 4*f* occupation in Yb. ▲

RIC Database

The total number of documents referenced in our system is now over 100,000. The documents are stored as citations in the RIC data base and represent books, journal articles, government, company, and laboratory reports, patents and theses, all of which contain information on rare earth metals, their alloys and compounds. A typical citation from a search contains the author(s) name(s), title of paper or contribution, reference line, and keywords that we have assigned to the citation after we have reviewed the document (see below).

200001120

Al-Omari;IA Zhou;J Sellmyer;DJ
Magnetic and structural properties of $SmCo_{6.75-x}Fe_xZr_{0.25}$ compounds
J. Alloys & Compounds, 298, 295-298, (2000)

2000	**(SMCOFEZR)**	**SM(CO,FE,ZR)7**	**MAGNETIZATION**
CURIE-TEMP	**MAG-PROP**	**PREPARATION**	**ALLOY**
STRUCTURE	**X-RAY-DIFFRACT**	**FE**	**COMPOSITION-EF**
UNIT-CELL	**LATTICE-PARAM**	**T=298**	**T>4.2**

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☛ *SOFC from previous column*

that doped $(La_{0.8}Ca_{0.2})CrO_3$ (LCC) and doped $Ce_{0.9}Gd_{0.1}O_{1.95}$ (CGO) are promising candidates for fuel cells operating at intermediate temperatures and directly oxidizing methane..

In tests, LCC powder was able to convert methane in a temperature-dependent relationship. CH_4 is efficiently oxidized directly to CO_2 and water at temperatures approaching 400°C. While carbon deposition on the oxide catalyst when excess methane CH_4 is present as temperatures approach 800°C, the introduction of oxygen at relatively low temperatures (300-400°C) removes the deposits.

LCC electrode materials are attractive because of their wide thermodynamic stability range and known applications as electrical conductors between fuel cells, and catalytic characteristics of CGO have been well known for some time. Both of these rare earth materials have good catalytic activity for methane oxidation, the former oxidizes methane to CO_2 and H_2O at ~400°C, and the reaction with CGO occurs at ~300°C.

Cerium-based catalysts such as CGO and $CeO_2 - ZrO_2$ used in automobile catalytic converters promote the reduction of Ce^{4+} to Ce^{3+}, which improves oxygen exchange processes and related catalytic reactions. Oxide electrodes instead of composite nickel-ceramic anodes are advantageous in that they are able to produce direct electrochemical oxidation of methane. However, a single-phase oxide material that meets all catalytic criteria at intermediate temperatures has not yet been discovered. A composite anode, doped with CeO_2 and mixed with another oxide that exhibits good electrical conductivity, could replace nickel composite anodes and increase efficiency and fuel cell operating lifetimes. ▲

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R&D 100 Awards

Oxymitter 4000 is the world's only sulfur-resistant oxygen sensor for automatic combustion control. It has proven to last 40 times longer than traditional Pt-Zr sensors when operating in a high-temperature environment. Traditional oxygen sensors use electrochemical cells that contain Pt electrodes that corrode rapidly in these adverse environments. Oxymitter 4000 uses a chemical modified Tb-YSZ (Terbium-doped Yttrium Stabilized Zirconia) refractory ceramic that resists corrosion from hot sulfur gases, which eliminates the need to frequently replace or calibrate sensors, ultimately increasing device dependability while lowering maintenance costs.

Ce ion-doped glass fibers that also contain lithium-6 atoms can detect presence of radionuclides such as plutonium. The detector operates when neutrons react with the lithium isotope to leave an ionization trail through the glass matrix, causing the Ce ion to emit light. Each fiber can detect from as little as one neutron and gamma ray, to millions of neutrons and gamma rays per second. This new technology will allow cost reductions in neutron detectors for specialized applications because of reduced cost.

See *R&D Magazine*, **41**, [10] p. 127 and p. 159 (1999); www.rdmag.com. ▲

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Since the December issue of the RIC News went to press, we have received support from one new family member and renewed support from 26 other organizations and individuals.

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